

IN THE CLAIMS

1. A method to pattern a substrate comprising:
 - a. forming a resist layer adjacent a substrate layer;
 - b. patterning the resist layer to leave discrete resist layer portions and exposed portions of the underlying substrate layer;
 - c. forming a hardmask layer adjacent the resist layer portions and exposed portions of the underlying substrate layer;
 - d. removing a portion of the hardmask layer to expose the resist layer portions;
 - e. removing the resist layer portions to leave discrete hardmask layer portions separated by patterned trenches, the discrete hardmask layer portions and trenches forming a hardmask pattern; and
 - f. transferring the hardmask pattern into the underlying substrate layer.
2. The method of claim 1 wherein forming the resist layer comprises spin coating a resist material.
3. The method of claim 1 wherein patterning the resist layer comprises exposing the resist layer to patterned radiation and removing portions of the resist layer subsequent to exposing by introducing a chemical developing agent.
4. The method of claim 1 wherein forming the hardmask layer comprises spin coating a hardmask material or depositing a hardmask material using chemical vapor deposition.

5. The method of claim 1 wherein removing a portion of the hardmask layer comprises introducing a chemical etchant for a period of time.
6. The method of claim 1 wherein removing a portion of the hardmask layer comprises planarizing the hardmask layer.
7. The method of claim 1 wherein removing the resist layer portions comprises introducing a wet chemical agent to decompose the resist layer portions.
8. The method of claim 1 wherein removing the resist layer portions comprises exposing the resist layer portions to radiation to make them soluble in a developer, and introducing said developer to remove the resist layer portions.
9. The method of claim 1 wherein transferring the hardmask pattern comprises introducing a wet chemical agent selective to the substrate layer.
10. The method of claim 1 wherein transferring the hardmask pattern comprises dry etching the underlying substrate layer through the patterned hardmask pattern to form a substrate decomposition from portions of the substrate layer.
11. The method of claim 10 further comprising introducing a carrier plasma to remove the substrate decomposition.

12. The method of claim 2 wherein the resist material comprises a spin-on photoresist material tuned for a radiation wavelength selected from the group consisting of about 248 nanometers, about 193 nanometers, about 157 nanometers, and about 10-15 nanometers.
13. The method of claim 2 wherein the resist layer comprises a spin-on photoresist material sensitive to electron irradiation.
14. The method of claim 1 wherein the substrate layer comprises a material selected from the group consisting of silicon, polysilicon, gallium arsenide, indium phosphide, indium antimonide, silicon dioxide, silicon carbide, silicon nitride, silicon oxynitride, carbon-doped oxide, aluminum, copper, tungsten, carbon, and polymers.
15. The method of claim 4 wherein the hardmask layer comprises a material selected from the group consisting of spin-on glass and spin-on organic material.
16. A method to form a trench in a substrate layer comprising:
 - a. forming a resist layer adjacent the substrate layer;
 - b. patterning the resist layer to leave a discrete resist layer portion covering a trench area of the substrate layer, the trench area of the substrate layer being the area in which the trench will be formed, and to expose portions of the substrate layer adjacent to the trench area of the substrate layer;
 - c. forming, after patterning the resist layer, a hardmask layer covering the exposed portions of the substrate layer;
 - d. exposing the trench area of the substrate layer by removing the discrete resist layer portion after forming the hardmask layer; and

- f. removing material from the exposed trench area of the substrate layer to form the trench.
- 17. The method of claim 16 wherein the formed hardmask layer also covers the discrete resist layer portion covering a trench area of the substrate layer, further comprising removing a portion of the hardmask layer to expose the discrete resist layer portion.
- 18. The method of claim 16 wherein the resist layer comprises a spin-on photoresist material sensitive to electron irradiation.
- 19. The method of claim 16 wherein the hardmask layer comprises a material selected from the group consisting of spin-on glass and spin-on organic material.